JC13 Rec'd PCT/PTO 04 APR 2002

FORM PTO-1390 (REV. 9-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 02165/HG

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 10/089868

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/SE00/01998	October 16, 2000	October 18, 1999

TITLE OF INVENTION: METHOD FOR PRODUCING POLYMER ROTORS

APPLICANT(S) FOR DO/EO/US: Mats SUNDSTRÖM and Karlis TIMUSKA

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [XX] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [XX] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [XX] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [XX] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [XX] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [XX] is attached hereto. (WO 01/28746 A1, published in English)
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [XX] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [XX] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [XX] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [XX] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [XX] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [XX] Other items or information:

(i) WO 01/28746 A1 (Publication of Appln.)
(ii) PCT/ISA/210 (Search Report)
(iii) PCT/IPEA/401 (DEMAND - CHAPTER II)
(iv) PCT/IPEA/409 (International Preliminary Examination Report)
(v) PCT/RO/101 (PCT REQUEST in English language)
(vi) ASSIGNMENT INFORMATION FOR PUBLICATION

Express Mail Mailing Label No.: EV 075 593 347 US
Date of Deposit: April 4, 2002

I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Asst. Commissioner for Patents, Washington, D.C. 20231

Laraine Dobies

JC13 Rec'd PCT/PTO 04 APR 2002

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/089868	PCT/SE00/01998	02165/HG

21 [XX] The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 1,040.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	x **$18.00**	$ --	
Independent claims	1 - 3 =	0	x **$84.00**	$ --	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$ 1,040.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$ 1,040.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 40.00	
TOTAL FEES ENCLOSED =				$ 1,080.00	
				Amount to be refunded:	$
				charged:	$

a. [XX] A check in the amount of $ 1,040 & $40 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [XX] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1378. A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

FRISHAUF, HOLTZ, GOODMAN LANGER & CHICK, P.C.
767 Third Avenue - 25th Floor
New York, NY 10017-2023

Tel. No. (212) 319-4900
Fax No. (212) 319-5101

01933
PATENT TRADEMARK OFFICE

SIGNATURE

Marshall J. Chick
NAME

26,853
REGISTRATION NUMBER

Date: April 4, 2002

10/089868
10089868.040402
JC13 Rec'd PCT/PTO 04 APR 2002

Attorney Docket No. 02165/HG

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Mats SUNDSTRÖM et al.

Serial No. : To be assigned (U.S. National Phase of PCT/SE00/01998 filed 10/16/2000)

Filed : CONCOMITANTLY HEREWITH

For : METHOD FOR PRODUCING POLYMER ROTORS

Art Unit :

Examiner :

Express Mail Mailing Label No.: EV 075 593 347 US
Date of Deposit: April 4, 2002

I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

Laraine Dobies

Laraine Dobies

In the event that this Paper is late filed, and the necessary petition for extension of time is not filed concurrently herewith, please consider this as a Petition for the requisite extension of time, and to the extent not tendered by check attached hereto, authorization to charge the extension fee, or any other fee required in connection with this Paper to Account No. 06-1378.

ATTENTION BOX PCT

PRELIMINARY AMENDMENT FILED CONCOMITANT WITH NATIONAL PHASE PCT APPLICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

S I R :

This application is a U.S. National Phase Application under 35 USC 371 of International Application PCT/SE00/01998 (published in English) filed October 16, 2000.

This is a PRELIMINARY AMENDMENT filed in the above-referenced national phase PCT application to amend claims in accordance with U.S. practice.

Please amend the claims as follows (see attached for details):

IN THE CLAIMS:

1. (Amended) A method of manufacturing a rotor for a helical screw machine that includes a metal shaft and helical lobes mutually separated by intermediate grooves, said metal shaft having a barrel surface, comprising the steps of

providing the shaft with a blind axially extending passageway;

connecting the passageway with the barrel surface of the shaft by means of at least one outwardly extending channel such that said at least one channel is located generally in the middle of the mould when the shaft is inserted therein;

inserting the rotor shaft into a mould that includes a barrel wall and two mutually spaced end-walls that include respective rotor shaft receiving openings, said openings embracing the rotor shaft at least in a generally sealing fashion;

heating the mould and the shaft to the curing temperature of the polymer;

pressing polymer forming materials into the axially extending passageway at an over pressure of at least one bar to deliver polymer-forming materials to the mould;

maintaining the barrel wall of the mould at said curing temperature until the polymer has cured; and

removing the rotor from the mould.

2. (Amended) A method according to Claim 1, further comprising providing the rotor shaft with a radially extending channel for each lobe, each of said channels being provided are disposed symmetrically around the circumference of the shaft.

3. (Amended) A method according to Claim 2, further comprising providing the channels offset relative to each other in the axial direction of the rotor shaft.

4. (Amended) A method according to Claim 2, further comprising positioning the shaft in the mould such that an outwardly directed channel opens into each lobe.

5. (Amended) A method according to Claim 2, further comprising providing the rotor shaft with helical recesses that have the same helical form as the lobes and that each intersect a respective channel.

6. (Amended) A method according to Claim 4, further comprising mixing the polymer forming material in the axially extending passageway.

7. (Amended) A method according to Claim 1, further comprising placing a static mixer in the central passageway and feeding a polymer-forming component through the opening of the mixer, and feeding a further polymer-forming component through the other opening.

8. (New) A method according to Claim 3, further comprising positioning the shaft in the mould such that an outwardly directed channel opens into each lobe.

9. (New) A method according to Claim 3, further comprising providing the rotor shaft with helical recesses that have the same helical form as the lobes and that each intersect a respective channel.

REMARKS

Entry of this AMENDMENT and a favorable action on the merits are respectfully requested.

Respectfully submitted,

Frishauf, Holtz, Goodman,
Langer & Chick, P.C.
767 Third Ave., 25th Floor
New York, NY 10017-2023
Tel. No. (212) 319-4900
Fax No.: (212) 319-5101
MJC/ld

MARSHALL J. CHICK
Reg. No. 26,853

Enclosure: MARKED-UP VERSION OF AMENDED CLAIMS

10/089868
JC13 Rec'd PCT/PTO 04 APR 2002

MARKED-UP VERSION OF AMENDED CLAIMS

1. (Amended) A method of manufacturing a rotor [(12,14)] for a helical screw machine that includes a metal shaft [(2,19)] and helical lobes [(9,15)] mutually separated by intermediate grooves [(13, 16)], said metal shaft having a barrel surface, comprising the steps of

providing the shaft [(2,19)] with a blind axially extending passageway [(10)];

connecting the passageway [(10)] with the barrel surface of the shaft [(2,19)] by means of at least one outwardly extending channel [(11)] such that said at least one channel is located generally in the middle of the mould when the shaft is inserted therein;

inserting the rotor shaft [(2, 19)] [in] into a mould [(1)] that includes a barrel wall and two mutually spaced end-walls [(4, 5)] that include respective rotor shaft receiving openings [(6 and 7)], said openings [(4, 5)] embracing the rotor shaft [(2,19)] at least in a generally sealing fashion;

heating the mould [(1)] and the shaft [(2, 19)] to the curing temperature of the polymer;

[delivering] pressing polymer forming materials into the axially extending passageway at an over pressure of at least one

bar to deliver polymer-forming materials to the mould [(1)];

maintaining the barrel wall [(3)] of the mould [(1)] at said curing temperature until the polymer has cured; and

removing the rotor from the mould [(1),

characterised by the further steps of disposing the outwardly extending channel (11) on the shaft (2, 19) such that said channels will be located generally in the middle of the mould (1) when the shaft (2, 19) is inserted therein; and pressing the polymer into the axially extending passageway (10) at an overpressure of at least 1 bar].

2. (Amended) A method according to Claim 1, [characterised by] further comprising providing the rotor shaft [(2 19)] with a radially extending channel [(11)] for each lobe [(9,15)], [wherewith the] each of said channels being provided [channels (11)] are disposed symmetrically around the circumference of the shaft.

3. (Amended) A method according to Claim 2, [characterised in that] further comprising providing the channels [(11) are] offset relative to each other in the axial direction of the rotor shaft [(2, 19)].

4. (Amended) A method according to Claim 2 [or 3], [characterised by] further comprising positioning the shaft [(2, 19)] in the mould [(1)] such that an outwardly directed channel [(11)] opens into each lobe [(9,15)].

5. (Amended) A method according to Claim 2 [or 3], further comprising [characterised by] providing the rotor shaft [(2, 19)] with helical recesses [(20)] that have the same helical form as the lobes [(9, 15)] and that each intersect a respective channel [(11)].

6. (Amended) A method according to Claim 4, [characterised by] further comprising mixing the polymer forming material in the axially extending passageway [(10)].

7. (Amended) A method according to Claim 1, [characterised by] further comprising placing a static mixer [(30)] in the central passageway [(10)] and feeding a polymer-forming component through the opening [(33)] of the mixer, and feeding a further polymer-forming component through the other opening [(34)].

METHOD FOR PRODUCING POLYMER ROTORS

The present invention relates to a method of manufacturing a polymeric rotor that includes a metal shaft having anchored thereon a polymeric body with helical lobes mutually separated by intermediate grooves, for a helical screw machine, such as a helical screw compressor and helical screw expander.

Rotors for helical screw machines include a metal shaft that has a rotor body affixed thereto. This rotor body has helical lobes mutually separated by grooves. Metal rotors are conventionally produced in one piece, whereas polymeric rotors have a metal shaft to which there is affixed a polymeric rotor body. The rotor body has at least two lobes, normally 4-7 lobes. A helical rotor machine will normally includes two mutually co-acting rotors, of which one rotor is a male rotor with typically relatively strong lobes, and the other rotor is a female rotor which normally has relatively weaker lobes. The rotor body surrounding the metal shaft is a coherent body in which the grooves separating the lobes have only a small material thickness, particularly in respect of a female rotor.

DE-A1-39 03 067 teaches the manufacture of a rotor for helical screw machines. According to this publication, a metal shaft is placed vertically in an open top matrix, whereafter a liquid polymer is either delivered to the outside of the shaft or through a passageway in the centre of the shaft, wherein channels extend radially to the shaft periphery from the lower end of the passageway. These channels open into the matrix at the lower end of the cavity to be filled with the liquid polymeric material. It is stated in the publication that this latter alternative is to be preferred when casting female rotors, that is to say female rotor bodies, of small thickness in the grooves between the lobes of the rotor. These radially extending channels open into the lower part of the cavity that has the smallest outer diameter.

When the polymer is delivered through the central passageway in the metal shaft in accordance with this publication, it is necessary that the polymer remains liquid in the lower part of the mould throughout the time taken to fill the mould completely. It is not until this has been achieved that conditions can be applied which cause the polymer to transform to a solid state in the lower part of the mould.

It has been found that rotors produced in this way have a smaller diameter in the centre of the rotor than at the ends thereof. The contraction or shrinkage that results in this hourglass shape may be due to the solidification of the polymer at a lower

temperature at the ends of the rotor than at its centre. The higher temperature in the centre of the rotor results in more pronounced shrinkage.

An object is to provide a method of manufacture that eliminates the drawbacks associated with the known method and therewith obtain rotors that do not have a waisted centre part in an axial direction.

In accordance with the present invention, a polymeric rotor for a helical screw machine that includes a metal shaft and at least two helical lobes mutually separated by intermediate grooves is manufactured by providing the shaft with an axially extending blind passageway, connecting the axially extending passageway with the barrel surface of the shaft by means of at least one radially extending channel, inserting the metal shaft in a mould comprising two mutually spaced end walls that include mutually opposed central openings that receive the rotor shaft, said openings sealingly enclosing the metal shaft at least generally, heating the mould and the metal shaft to the polymer curing temperature, delivering polymer-forming materials to the mould, maintaining the mould and the metal shaft at said curing temperature until the polymer has been cured, and then removing the metal shaft with rotor from the mould. The inventive method is characterised in that the radial channel extending outwards from the passageway is arranged in a manner such that said channel will be situated generally in the middle of the mould when the shaft is inserted thereinto, and in that the polymer is pressed into the axially extending passageway at an overpressure of at least 1 bar.

Preferred embodiments of the method will be apparent from the dependent Claims. The polymer material, release agent, and filler may be those described in the German reference or other materials known to the person skilled in this art.

According to one preferred embodiment of the invention, the metal shaft includes helical recesses or grooves that are filled with polymeric material and that form a sunken part of the outwardly lying lobe. The recesses or grooves will preferably have a parallel trapezium cross-section, with the shorter of the parallel sides located nearest the shaft periphery and extending perpendicularly to the shaft radius. The corners at the transition from the non-parallel sides to the shaft periphery are rounded, to reduce the fracture tendency of the polymeric material.

The helical grooves may extend along the full length of the lobe or solely along a part thereof. Similarly, the helical grooves may be two or more along part-grooves disposed along the same helical line. In this latter case, it is preferred that an outwardly directed channel opens into each part-groove.

According to the invention, the term metal alloys includes, for instance, steel and brass, wherewith steel is particularly preferred. The polymeric material may be polyurethane containing inorganic filler, for instance silicate-containing fibres.

The invention will now be described by way of example and with reference to the accompanying drawing, in which

Figure 1 is a schematic longitudinal section view of a mould according to the invention and shows a metal shaft inserted in the mould;

Figure 2 is a sectional view of the metal shaft, taken on the line II-II in Figure 1;

Figure 3 is a sectional view of a first form of a known rotor end profile, taken on the line III-III in Figure 1;

Figure 4 is a sectional view of a second embodiment of a rotor end profile, taken on the line III-III in Figure 1; and

Figure 5 is a schematic vertical sectional view of a static mixer.

Figure 1 shows a mould 1 in which a metal shaft, preferably a steel shaft 2, is inserted. The barrel wall 3 of the mould 1 has a cylindrical outer surface and internally the outer contour of a helical rotor, which in the illustrated case includes five lobes and an equal number of intermediate grooves, as shown in Figure 3. The mould 1 includes an upper circular end-wall 4 and a lower circular end-wall 5. Each of the end-walls 4, 5 is provided with a respective central, shaft-receiving opening 6 and 7. The openings 6, 7 embrace the rotor shaft 2, such as to at least generally seal against said shaft. The mould 1 includes in the upper part of the barrel wall 3 an air vent 8 for each rotor lobe 9, as will be seen from Figure 3. These air vents 8 may also be disposed as grooves in the upper end-wall 4.

The rotor shaft 2 has at its lower end a central, axially extending passageway 10 that extends more than half way into the shaft 2. As will be seen from Figure 1, those end-parts of the shaft 2 that are located outside the end-walls 4, 5 are of equal lengths. If the shaft 2 is placed asymmetrically in the mould 1, the length of the axial passageway 10 will extend beyond the centre of the mould 1 surrounding the shaft.

At least one radial channel 11 extends to the periphery of the shaft 2 from the passageway 10. The number of radial channels 11 extending from the axial passageway 10 to the periphery of the shaft will preferably equal the number of lobes 9 to be provided on the rotor. These radial channels 11 are preferably offset relative to each other in the axial direction of the shaft, so as to reduce or minimise weakening of the shaft in the region of said channels 11.

Figure 2 shows the shaft 2 and one such radial channel 11 and two further channels 11' and 11" shown in broken lines, these further channels being located beneath the surface of the section. Although not shown, the shaft includes a further two radial channels 11 above the section surface.

Figure 3 illustrates an end section of a male rotor 12 that has five lobes 9. These lobes 9 are mutually separated by grooves 13. It will be apparent from this Figure that the mould has five air vents 8 in its upper part.

Figure 4 is an end section of a female rotor 14 that has six lobes 15 and six intermediate grooves 16, said rotor being inserted in a mould 17. The rotor is formed in accordance with the invention. The rotor body 14 is disposed on a steel shaft 19 and has the form of six individual and mutually separated lobes 15. It will be seen from the Figure that the bottoms of respective grooves 16 between the lobes 15 are formed by the steel shaft 19. The lobes 15 are thus not mutually connected by polymeric material as in the case of the lobes 9 of the male rotor shown in Figure 3. The mould includes six air vents 18. The rotors produced in accordance with Figures 3 and 4 are not intended to interact with each other.

As will be seen from Figure 4, the shaft 19 includes recesses 20 that are trapezoidal in cross-section, wherewith the longer of the mutually parallel surfaces face towards the centre point of the shaft 19. The non-parallel surfaces have rounded corners at the shaft periphery. These trapezoidal recesses 20 widen in the same helical shape as the outwardly lying lobe 15. In one preferred embodiment of the invention, each radial channel 11 (Figure 2) opens into one such recess 20. The recesses 20 widen from the radial channel 11 over a longer or shorter distance. In the case of the embodiment shown in Figure 4, the recess 20 has the same length as the lobe 15. These recesses 20 are effective in the affixment of the polymer in the shaft 19. The rounded corners at the periphery of the shaft 19 reduce the risk of crack formation and lengthen the useful life of the rotor.

Figure 5 is a schematic vertical sectional view of a static mixer 30 for use in moulding inventive polymeric rotors. The mixer 30 includes a first conduit 31 that has two inlet openings 33, 34 at respective ends thereof. A third opening 35 that connects with one end of a second conduit 32 is provided in the conduit wall between said openings 33, 34. This second conduit includes a number of mixing elements 36, which may be helically shaped. The elements 36 are arranged to prevent material passing

axially through the second conduit 32 without mixing. Such static mixers are known to the art.

According to the invention, a liquid or solid polymeric material, e.g. polyurethane, preferably containing filler, is delivered to the axially extending, central passageway 10 at a temperature of about 30°C and at an overpressure of at least about 1 bar and at most about 15 bar. The preferred pressure lies about midway of this pressure range. The mould 1 and the shaft 2 have been heated to a temperature of about 90°C. A release agent may have been applied to the inner surface of the mould 1 prior to delivering the polymeric material. The barrel 3 of the mould is also heated electrically so as to maintain a temperature of about 90°C, this being done conventionally. The shaft 2 and the end-walls 4, 5 of the mould have a high thermal capacity and are therefore not heated. The polymeric material delivered to the axially extending passageway 10 leaves said passageway through the radially disposed channels 11.

The material exiting from the radial channels 11 first flows down in the upstanding mould 1 and thereafter rises in the mould cavity until the mould has been filled. Because the material delivered has a much lower temperature than the shaft 2 and the mould 1, the material will take up heat as it is delivered, while cooling the shaft 2 and the non-heated end surfaces. Because the material is delivered centrally in the mould 1, the material will be located where the lowest temperature prevails at the beginning of the solidification process. The fact that the material is delivered under a relatively high overpressure in precisely the centre of the mould 1, shrinkage of the polymer, normally occurring in the centre, is compensated for so that the rotor will not have a smaller diameter in the midway zone of the rotor than the diameter of the ends of the rotor.

According to a second embodiment of the invention, a static mixer 30 is placed in the central passageway 10. The length of the second conduit 32 of the static mixer is such that when the mixer is inserted it will only reach as far as the radially extending channels that lie nearest the orifice of the central passageway. This enables two components that together form the polymer after being cured to be delivered through a respective opening 33, 34 of the static mixer 30, said components passing through the opening 35 and into the second conduit 32 of the mixer. The components are mixed in the second conduit with the aid of the mixing elements 36, which induce lateral movement of the material.

CLAIMS

1. A method of manufacturing a rotor (12, 14) for a helical screw machine that includes a metal shaft (2, 19) and helical lobes (9, 15) mutually separated by intermediate grooves (13, 16), comprising the steps of

- providing the shaft (2, 19) with a blind axially extending passageway (10);
- connecting the passageway (10) with the barrel surface of the shaft (2, 19) by means of at least one channel (11);
- inserting the rotor shaft (2, 19) in a mould (1) that includes two mutually spaced end-walls (4, 5) that include respective rotor shaft receiving openings (6 and 7), said openings (4, 5) embracing the rotor shaft (2, 19) at least in a generally sealing fashion;
- heating the mould (1) and the shaft (2, 19) to the curing temperature of the polymer;
- delivering polymer-forming materials to the mould (1);
- maintaining the barrel wall (3) of the mould (1) at said curing temperature until the polymer has cured; and
- removing the rotor from the mould (1),

characterised by the further steps of disposing the outwardly extending channel (11) on the shaft (2, 19) such that said channels will be located generally in the middle of the mould (1) when the shaft (2, 19) is inserted therein; and pressing the polymer into the axially extending passageway (10) at an overpressure of at least 1 bar.

2. A method according to Claim 1, **characterised** by providing the rotor shaft (2, 19) with a radially extending channel (11) for each lobe (9, 15), wherewith the channels (11) are disposed symmetrically around the circumference of the shaft.

3. A method according to Claim 2, **characterised** in that the channels (11) are offset relative to each other in the axial direction of the rotor shaft (2, 19).

4. A method according to Claim 2 or 3, **characterised** by positioning the shaft (2, 19) in the mould (1) such that an outwardly directed channel (11) opens into each lobe (9, 15).

5. A method according to Claim 2 or 3, **characterised** by providing the rotor shaft (2, 19) with helical recesses (20) that have the same helical form as the lobes (9, 15) and that each intersect a respective channel (11).

6. A method according to Claim 4, **characterised** by mixing the material in the axially extending passageway (10).

7. A method according to Claim 1, **characterised** by placing a static mixer (30) in the central passageway (10) and feeding a polymer-forming component through the opening (33) of the mixer, and feeding a further polymer-forming component through the other opening (34).

1008928682.040402

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2001 (26.04.2001)

PCT

(10) International Publication Number
WO 01/28746 A1

(51) International Patent Classification[7]: B29C 39/10, F04C 18/16

(21) International Application Number: PCT/SE00/01998

(22) International Filing Date: 16 October 2000 (16.10.2000)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
9903772-3 18 October 1999 (18.10.1999) SE

(71) Applicant *(for all designated States except US)*: SVENSKA ROTOR MASKINER AB [SE/SE]; Box 15085, S-104 65 Stockholm (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: SUNDSTRÖM, Mats [SE/SE]; Strandskatevägen 17, S-134 62 Ingarö (SE). TIMUSKA, Karlis [SE/SE]; Valhallavägen 16, S-114 22 Stockholm (SE).

(74) Agent: WIEDEMANN, Bernd; Svenska Rotor Maskiner AB, Box 15085, S-104 65 Stockholm (SE).

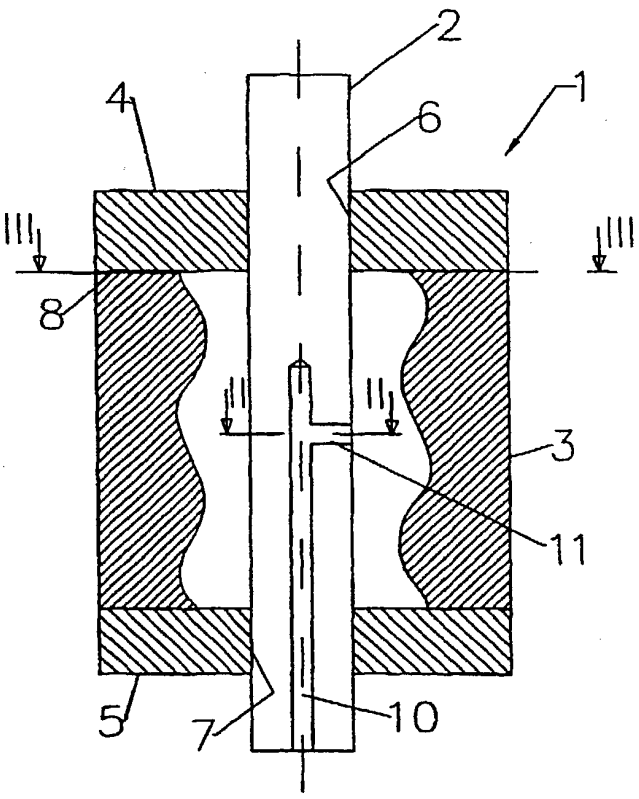
(81) Designated States *(national)*: JP, KR, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR PRODUCING POLYMER ROTORS



(57) Abstract: The invention relates to a method of manufacturing a rotor (12) for a helical screw machine that includes a metal shaft (2) and helical lobes (9) mutually separated by intermediate grooves (13), comprising the steps of providing the shaft (2) with a blind axially extending passageway (10); connecting the passageway (10) with the barrel surface of the shaft (2) by means of at least one channel (11) extending outwardly from the shaft; inserting the rotor shaft (2) in a mould (1) that includes two mutually spaced end-walls (4, 5) which have respective rotor shaft receiving openings (6 and 7), said openings (4, 5) embracing the rotor shaft (2, 19) at least in a generally sealing fashion; heating the mould (1) and the shaft (2) to the curing temperature of the polymer; delivering polymer-forming materials to the mould (1); maintaining the barrel wall (3) of the mould (1) at said curing temperature until the polymer has cured; and removing the rotor from the mould (1). The method is characterised by the further steps of disposing the outwardly extending channel (11) on the shaft (2) such that said channel will be located generally in the middle of the mould (1) when the shaft (2) is inserted therein; and pressing the polymer into the axially extending passageway (10) at an overpressure of at least 1 bar.

WO 01/28746 A1

1/2

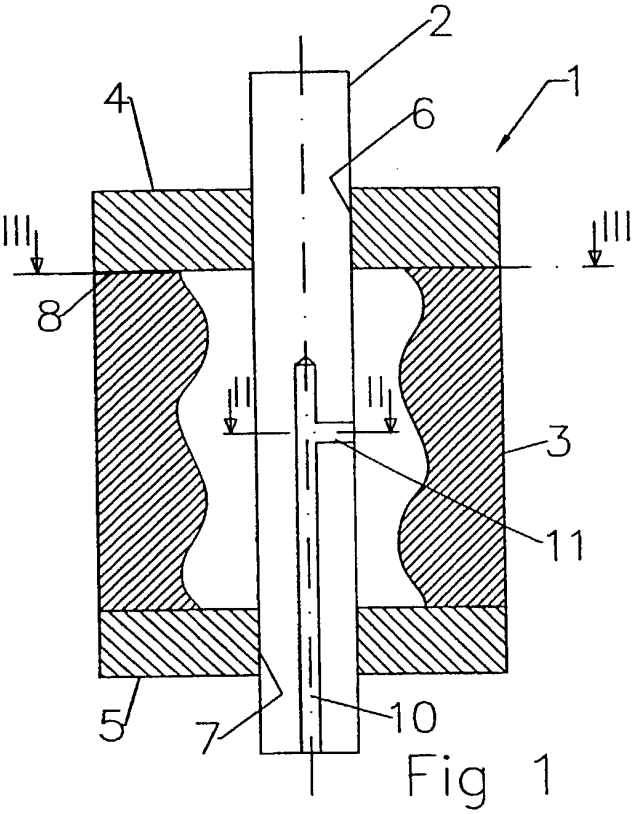


Fig 1

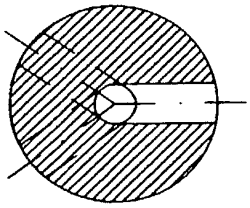


Fig 2

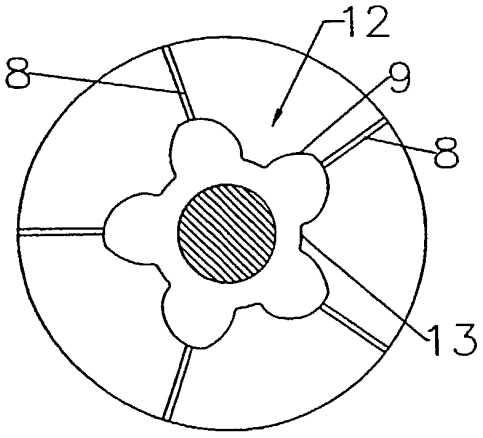


Fig 3

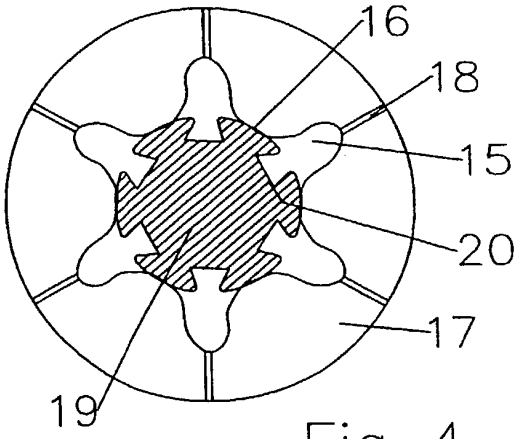


Fig 4

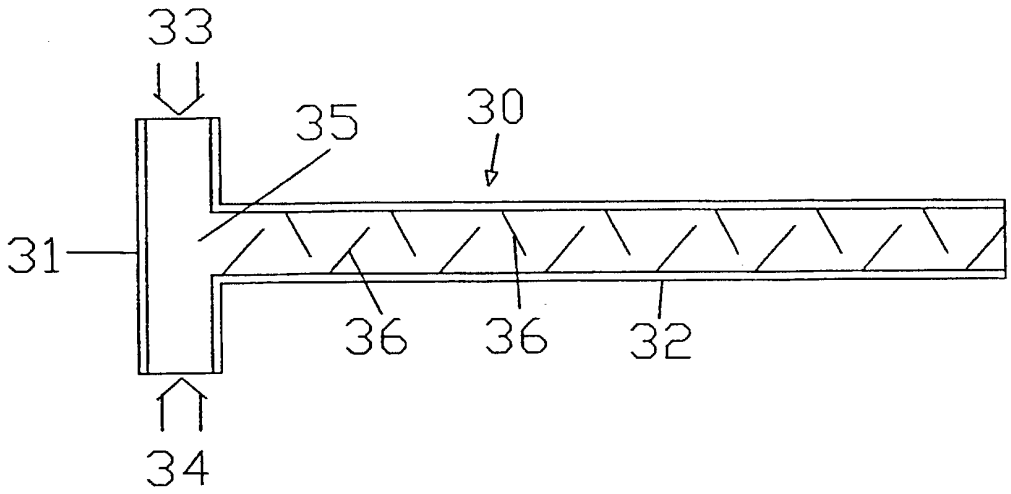


Fig 5

10/96FHGL&C U.S. Attorney Docket 02165/LH

APPLICATION FOR UNITED STATES LETTERS PATENT

PCT Declaration and Power of Attorney (35 U.S.C. 371(c)(4))
PCT Application - United States Designated Office

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"METHOD FOR PRODUCING POLYMER ROTORS"

described and claimed in International Application number PCT/SE00/01998 filed October 16, 2000
and, if it was amended, as amended on

I have reviewed and understand the contents of said specification, including claims.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I claim priority benefits under 35 USC §119 of: (i) any foreign application(s) for patent or inventor's certificate listed below; or (ii) any United States provisional application(s) listed below; and have also identified below any foreign application(s) for patent or inventor's certificate, or PCT international application having a filing date before that of the application(s) on which priority is claimed.

COUNTRY	APPLICATION NUMBER	DATE (day, month, year)	PRIORITY CLAIMED
Sweden	9903772-3	18 OCT 1999	yes X no
			yes no

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I appoint the following attorneys to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith: Leonard Holtz, Reg. No. 22,974; Herbert Goodman, Reg. No. 17,081; Thomas Langer, Reg. No. 27,264; Marshall J. Chick, Reg. No. 26,853; Richard S. Barth, Reg. No. 28,180; Douglas Holtz, Reg. No. 33,902; and Robert P. Michal, Reg. No. 35,614.

CORRESPONDENCE AND CALLS TO: ERISHAUF, HOLTZ, GOODMAN, LANGER & CHICK, P.C.
767 Third Avenue - 25th Floor Tel.: (212) 319-4900
New York, New York 10017-2023 Fax.: (212) 319-5101

INVENTOR: SIGNATURE	DATE	RESIDENCE AND POST OFFICE ADDRESS
Sign: [signature]	Date: March 21, 2002	Residence: (City & Country) Ingarö, Sweden SEX Post Office Address: Strandskatevägen 17, S-134 62 Ingarö, Sweden
Type: Mats SUNDSTRÖM	Citizen of: Sweden	
Sign: [signature]	Date: March 21, 2002	Residence: (City & Country) Stockholm, Sweden SEX Post Office Address: Valhallavägen 16, S-114 22 Stockholm, Sweden
Type: Karlis TIMUSKA	Citizen of: Sweden	
Sign:	Date:	Residence: (City & Country) Post Office Address:
Type:	Citizen of:	